

Claims

1. Internal combustion engine installation (10), which has a directly injected gasoline engine (12), which is hardly, if at all, capable of stratified operation, and a catalyst system (16), which has at least one catalyst (18) and is disposed downstream from the gasoline engine (12), characterized in that a catalyst system (16) overall has a catalyst volume (KV) of less than $0.8 \times$ the engine displacement (VH) or often less than 1.3 per 100 kW of rated horsepower of the engine (PNENN) and that the average specific loading of noble metal of the at least one catalyst (18) of the catalyst system (16) is less than 3.59 g/dm³, the total mass of noble metal of the at least one catalyst (18) being less than 2 g per liter of engine displacement (VH) or less than 3.5 g per 100 kW of rated horsepower (PNENN) of the gasoline engine 12.
2. The internal combustion engine installation of claim 1, characterized and that the catalyst system (16) has a total catalyst volume (KV) of less than $0.7 \times$ the engine displacement (VH).
3. The internal combustion engine installation of claim 1, characterized in that the catalyst system (16) has a total catalyst volume (KV) of less than $0.6 \times$ the engine displacement (VH).
4. The internal combustion engine installation of claim 1, characterized in that the catalyst system (16) has a total catalyst volume (KV) of less than 1.15 L per 100 KW of the rated engine horsepower (PNENN).
5. The internal combustion engine installation of claim 1, characterized in that the catalyst system (16) has a total catalyst volume (KV) of less than 1.00 L per 100 KW of the rated engine horsepower (PNENN).

6. The internal combustion engine installation of claim 1, characterized in that the catalyst system (16) has a total catalyst volume (KV) of less than 0.85 L per 100 KW of the rated engine horsepower (PNENN).

7. The internal combustion engine of one of the claims 1 to 6, characterized in that the catalyst system consists of at least two catalysts (18), disposed parallel to one another, or of one catalyst (22) with at least two pre-catalysts (20), disposed parallel to one another, or of at least two main catalysts (22), disposed parallel to one another, with in each case at least one pre-catalyst (20).

8. The internal combustion engine installation of one of the claims 1 to 7, characterized in that the average specific loading with noble metal of the at least one catalyst (18) of the catalyst system (16) is not more than 2.87 g/dm³.

9. The internal combustion engine installation of one of the claims 1 to 7, characterized in that the average specific loading with noble metal of the at least one catalyst (18) of the catalyst system (16) is not more than 2.15 g/dm³.

10. The internal combustion engine installation of one of the claims 1 to 8, characterized in that the noble metal loading of the pre-catalyst or pre-catalysts (20) is up to 70% higher than that of the main catalyst or catalysts (22).

11. The internal combustion engine installation of one of the claims 1 to 8, characterized in that the noble metal loading of the pre-catalyst or pre-catalysts (20) is up to 50% higher than that of the main catalyst or catalysts (22).

12. The internal combustion engine installation of one of the claims 1 to 8, characterized in that the noble metal loading of the pre-catalyst or pre-catalysts (20) is up to 30% higher than that of the main catalyst or catalysts (22).

13. The internal combustion engine installation of one of the claims 1 to 12, characterized in that the total mass of noble metal in the catalyst system (16) is less than 1.6 g per liter of engine displacement (VH) of the gasoline engine (12).

14. The internal combustion engine installation of one of the claims 1 to 12, characterized in that the total mass of noble metal in the catalyst system (16) is less than 1.2 g per liter of engine displacement (VH) of the gasoline engine (12).

15. The internal combustion engine installation of one of the claims 1 to 12, characterized in that the total mass of noble metal in the catalyst system (16) is less than 1.0 g per liter of engine displacement (VH) of the gasoline engine (12).

16. The internal combustion engine installation of one of the claims 1 to 12, characterized in that the total mass of noble metal in the catalyst system (16) is less than 0.8 g per liter of engine displacement (VH) of the gasoline engine (12).

17. The internal combustion engine installation of one of the claims 1 to 12, characterized in that the total mass of noble metal in the catalyst system (16) is less than 3 g per 100 kW of rated horsepower of the gasoline engine (12).

18. The internal combustion engine installation of one of the claims 1 to 12, characterized in that the total mass of noble metal in the catalyst system (16) is less than 2.5 g per 100 kW of rated horsepower of the gasoline engine (12).

19. The internal combustion engine installation of one of the claims 1 to 12, characterized in that the total mass of noble metal in the catalyst system (16) is less than 2.1 g per 100 kW of rated horsepower of the gasoline engine (12).

20. The internal combustion engine installation of one of the claims 1 to 12, characterized in that the total mass of noble metal in the catalyst system (16) is less than 1.7 g per 100 kW of rated horsepower of the gasoline engine (12).

21. The internal combustion engine installation of one of the claims 1 to 20, characterized in that the at least one catalyst (18) or the at least one pre-catalyst (20) is at a distance of less than 800 mm exhaust gas pipeline length from the nearest outlet valve of the gasoline engine (12).

22. The internal combustion engine installation of one of the claims 1 to 20, characterized in that the at least one catalyst (18) or the at least one pre-catalyst (20) is at a distance of less than 500 mm exhaust gas pipeline length from the nearest outlet valve of the gasoline engine (12).

23. The internal combustion engine installation of one of the claims 1 to 20, characterized in that the at least one catalyst (18) or the at least one pre-catalyst (20) is at a distance of less than 300 mm exhaust gas pipeline length from the nearest outlet valve of the gasoline engine (12).

24. The internal combustion engine installation of one of the claims 7 to 23, characterized in that the at least one pre-catalyst (20) and the at least one downstream, main catalyst (22) are at a distance of more than 100 mm from one another.

25. The internal combustion engine installation of one of the claims 7 to 24, characterized in that the at least one pre-catalyst (20) has a volume of not more than 70% of the at least one downstream main catalyst (22).

26. The internal combustion engine installation of one of the claims 7 to 24, characterized in that the at least one pre-catalyst (20) has a volume of not more than 50% of the at least one downstream main catalyst (22).

27. The internal combustion engine installation of one of the claims 7 to 24, characterized in that the at least one pre-catalyst (20) has a volume of not more than 30% of the at least one downstream main catalyst (22).

28. The internal combustion engine installation of one of the claims 1 to 26, characterized in that the catalyst or catalysts of the catalyst system (16) are based on a ceramic support.

29. The internal combustion engine installation of one of the claims 1 to 26, characterized in that the at least one catalyst (18) or the at least one main catalyst (22) are based on a ceramic support.

30. The internal combustion engine installation of claims 28 or 29, characterized in that the catalyst or catalysts (18) or main catalyst (22), based on a ceramic support, have a cell density of more than 500 cpsi and that the product of cell density (in cpsi = cells per square inch) and cell wall thickness (in mil = thousandths of an inch) is less than 2700, which corresponds to 0.1063 when the cell density is expressed in cells per square millimeter and the cell wall thickness in millimeters.

31. The internal combustion engine installation of one of the claims 7 to 30, characterized in that the at least one pre-catalyst (20) has a support based on metal foil.

32. The internal combustion engine installation of claim 31, characterized in that the at least one pre-catalyst (20) has a cell density of more than 500 cpsi and the product of the cell density (in cpsi = sales per square inch) and the

cell wall thickness (in μ = thousands of a millimeter) is less than 30,000 and preferably less than 20,000, corresponding to less than 46.5 and preferably less than 31 when the cell density is expressed in cells per square millimeter.

33. The internal combustion engine installation of one of the claims 1 to 32, characterized in that the gasoline engine (12) is capable of stratified operation at less than 7% of all operating points.

34. The internal combustion engine installation of one of the claims 1 to 32, characterized in that the gasoline engine (12) is capable of stratified operation at less than 5% of all operating points.

35. The internal combustion engine installation of one of the claims 1 to 32, characterized in that the gasoline engine (12) is capable of stratified operation at less than 3% of all operating points.

36. The internal combustion engine of one of the claims 1 to 32, characterized in that the gasoline engine 12 is naturally aspirated.